

Improvements in and relating to Blast and Collision Protection Structures

This invention relates to blast and collision protection structures of the type which are inflatable and which, in use, contain a liquid such as water as a means of mitigating the effects of an explosion blast from e.g. a car bomb or of a collision with e.g. a car.

In GB2374625, the disclosure of which is incorporated herein by reference, there are described inflatable structures in the form of rupturable flexible containers which may typically be initially filled with air so as to provide the required shape, whereafter the air is replaced by water by means of a pressure relief valve. The required shape is preferably maintained by the use of drop stitches between opposing internal walls of the structure so that, especially where the structure comprises a simple shape, such as a cube, individual structures can be mounted side-by-side and/or on top of other such structures to form a protective wall which, when filled with water, can mitigate against explosive blasts and/or the effects of collisions. More intricate shapes are also possible but because of the inherent weight and liquidity of water it has been found heretofore that there is a practical limit to the height that such structures can reach without requiring separate mechanical support. As will be appreciated, in the environment in which such structures are intended to operate, mechanical support in the form of rigid supports themselves pose a danger of effectively becoming shrapnel when e.g. the structure is placed next to an explosive device which is then detonated such that as a practical matter a prerequisite of such inflatable water-filled containers is that they should not

include or rely on any rigid materials and should instead be self-supporting in-use.

The present invention is derived from the realisation that a relatively high structure can be achieved through the use in combination of opposing pairs of walled water-containing or containable containers which are at least partially supported in-use by inflatable air-filled containers therebetween.

According to the invention there is provided shock suppression apparatus for suppressing the effects of an explosion or collision, the apparatus comprising or including a pair of inflatable spaced-apart walled containers connected or connectable at respective upper ends to each other, either directly or indirectly, and connected or connectable at their respective lower ends to each other, either directly or indirectly, and inflatable support cushion means disposed between the walled containers to at least partially support the walls thereof against collapse when such are filled with water.

Conveniently, the upper ends of the walled containers are connected together by webbing or strapping and the lower ends are splayed apart and connected to an inflatable base to form in combination therewith a structure of generally triangular section when inflated, whereafter following inflation of the support means, which may be partially or wholly of triangular section, so as to provide full support or partial support, as the case may be, the walled containers are then filled with water and the inflatable cushion thereafter prevents inward collapse under the weight of water.

Conveniently, the walls of the walled containers at least may be interconnected by drop stitches so as to prevent or inhibit outward bulging

thereof in response to the weight of water contained therein. Alternatively, each walled container may be comprised of a number of individual segments or cells which thereby minimise the tendency of each segment or cell to jeopardise the overall required shape of the walled containers by collapsing under the weight of water. Instead of drop stitch construction, the internal walls of the walled containers may be interconnected by straps at strategic locations, which may conveniently be heat-welded in place.

Conveniently, the walled containers overlap with each other in a stepped or staggered formation such that adjoining ones of each apparatus may be interlinked to form a continuous wall of such structures. These may conveniently be interlinked with each other along the line of the wall by support webbing/strapping, such as through the use of strips of Velcro® webbing or strapping stitched to each one and adapted to interconnect with adjacent ones of such support structures.

In a further refinement to the invention the support means may contain air or liquid or a mixture of both which may contain e.g. a fire retardant/suppressant or some other useful material which may be released following an explosion or collision event.

The invention will now be described, by way of example only, with reference to the following drawings in which:

Figure 1 is a schematic sectional view of shock suppression apparatus according to an embodiment of the invention,

Figure 2 is a plan view of the embodiment of Figure 1, and

Figure 3 is a plan view of a plurality of the apparatus shown in Figures 1 and 2 interconnected.

Referring firstly to Figures 1 and 2 there is shown shock (such as blast and/or collision) suppressing apparatus in the form of a pair of oppositely disposed inflatable walled containers 1,2 secured together at their respective upper, sealed, ends by means of webs 3 extending thereacross which may be stitched to the fabric of each of the containers 1,2 or may be releasably securable such as through the use of e.g. Velcro® strips etc.

The lower end of each walled container 1,2 is connected to an inflatable base 4 comprising a walled container which may be inflated to the position shown. The base 4, in combination with the two walled sides 1,2, forms a generally triangular structure in section having a correspondingly shaped void or hollow therebetween into which may be disposed support means in the form of an inflatable cushion 5 of generally frusto-triangular shape for supporting the mid to lower portions of the walled containers 1,2 from inward collapse when the latter are filled with water.

As will be seen with reference to Figure 2, the walled containers 1,2 are connected to each other by the straps 3 in a stepped or staggered formation so that adjacent structures can overlap in a manner to be described. The base container 4 is arranged in this embodiment symmetrically relative to this staggered formation although it will be appreciated that it could instead be disposed wholly underneath one or other of the walled containers 1 or 2 or may be shorter than as shown in the drawing so that the edges do not project beyond the walled containers 1,2 when seen in plan view. Similarly, although the walled

containers 1,2 are shown staggered with respect to each other they may not be and may instead be perfectly symmetrical with each other relative to the base container 4.

5 In use, water is introduced into the containers 1, 2 and 4 by any suitable means although in a preferred arrangement this is by first of all introducing air under pressure so that the structure assumes the desired shape, in this case one of generally triangular section, whereafter the air is then gradually replaced with water through the use of e.g. a pressure release valve (not shown). Ordinarily, if the height of the resulting structure is relatively small, perhaps one 10 or two metres tall, the structure could be self-supporting but, as will be apparent, for taller structures of three or even four metres it would ordinarily require for that purpose rigid mechanical support, such as by the use of self-supporting booms, spars or such other rigid framework as are described in GB2289750, where metal "rungs" are used to support lay-flat plastics tubing filled with water. 15 However, the invention provides an alternative method of supporting the walled containers 1,2 from inward collapse through the use of the inflatable cushion 5 which, if positioned as shown prior to the walled containers 1,2 being completely filled with water, provides enough support for the structure to retain its required shape until completely filled with water and pressurised to the extent that the 20 walled containers 1,2 either become entirely self-supporting, in which case the support cushion 5 may thereafter be removed, to be reused to erect a similar structure, or left in place as additional support.

Turning now to Figure 3, there is shown a schematic plan view of a wall of such shock suppression structures in which it will be seen that adjacent pairs

interlock with each other by virtue of the staggered or stepped arrangement of the oppositely disposed walled containers 1,2, the ensuing walled structure being similar in concept to the construction of a brick wall such that the joints between adjacent walled containers 1 do not coincide with the joints of  
5        respective walled containers 2, the overlap thereby ensuring that on the occurrence of an explosion or collision event adjacent thereto the integrity of the entire walled structure is not compromised in the immediate aftermath of such an event, thereby allowing the water to partially or wholly absorb the energy of the blast and/or collision.

10        In a further refinement, the shock suppression apparatus may be reinforced with webbing or strapping, such as by strips of Velcro®, running lengthways along the top, sides and/or bottom of the wall such that although it is composed of a number of individual inflatable structures as shown in Figures 1 and 2 the resultant composite wall structure may effectively be regarded as a  
15        single structure having the known advantages for suppressing the effects of an explosion or collision through the use of water, without using any rigid parts and whilst retaining sufficient height to ensure that damage to adjacent buildings etc. is minimised, as compared to existing self-supporting non-rigid structures of lower height.

20        Although the embodiment described comprises an essentially triangular structure in section in which the support means therefore is in the form of a frusto-triangular inflatable cushion, it will nevertheless be apparent that other shapes may be possible using this general method of construction without departing from the spirit or scope of the invention.